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EXPLORING THE MANAGEMENT OF OUTSOURCING AND THE DETERMINATION OF CIVIL ENGINEERING MINIMUM MANNING NUMBERS IN ORDER TO OPTIMIZE AIR FORCE BENEFITS

THESIS

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THESIS

Captain David J. Anason

Presented to the Faculty of the Graduate School of Engineering

of the Air Force Institute of Technology

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Engineering and Environmental Management

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Abstract

This thesis investigates the relationship between peacetime and wartime tasks for Air Force Civil Engineering career fields in regard to outsourcing. Relevant literature in civilian sector outsourcing techniques is then studied to determine how they decide on what to outsource and what to keep insourced. Peacetime tasks performed by individual career fields are correlated with the wartime tasks to determine if there is any valuable wartime training gained from the completion of peacetime work orders. Several interviews were completed with Air Force Civil Engineer readiness experts to evaluate an importance factor for each career field wartime mission. This importance factor and the wartime correlation is then coded into a mathematical system dynamics model. This model enumerates different decision-maker profiles of outsourcing motivation in order to predict long term trends of manning authorizations given the wartime correlation and importance factors. Different specific dynamic cases are then discussed and possible predictors for optimization are suggested.

Chapter 1
Introduction

Since the end of the cold war the United States Air Force has faced a changing global mission with a declining budget. The need to modernize the force amidst these changes has forced new reorganization strategies. Outsourcing is one strategy that can be used to streamline and save money.

Outsourcing is transferring the performance of a function previously accomplished in-house to an outside provider. Basically, it's paying someone else to do what the military used to do. It is not the elimination of a service or function, but vesting it in either a civilian contractor or civilian government employees.

Privatization is transferring ownership and control of an activity and its associated assets to an outside provider. This is getting out of the business all together. The Air Force will have no responsibility or control over this item any more. The outside provider will own, operate, and maintain the resources to accomplish the job.

With outsourcing, the Air Force started to look at its wartime missions *and* its peacetime missions. Some were very easily distinguishable, but others were not. If the Air Force was to pursue this outsourcing philosophy, there had to be no effect on its war fighting capabilities. For example, the pilots that fly the missions have a definite wartime task which cannot be replaced by civilian contractors. But, the aircraft maintenance troops do a job very similar to the maintenance workers in airline companies. The CONUS bases were targeted first to be outsourced. Aircraft maintenance deploys with their planes to the theater. Maintenance organizations of air training bases that only flew

trainer type aircraft never needed to deploy and were outsourced. These contracted out maintenance squadrons will never find themselves in a combat situation.

With some jobs in the Air Force, it is not as easy to distinguish whether the overall mission is combat or peacetime related. Air Force Civil Engineers have dual roles. First, in a peacetime setting they are responsible for the upkeep of the base. They perform routine maintenance of buildings, pavements, and airfield lighting, but routine maintenance is not the only action they perform. Second, in a wartime setting, Civil Engineers are one of the first Air Force teams to arrive in the area of conflict. Their job is to set up a bare base. This entails providing water, electricity, sewage, shelter, aircraft fueling areas, and aircraft parking areas for the incoming forces. After the initial bed down, Air Force Civil Engineers stay and maintain this new base the same way they do their jobs during peacetime, although in a hostile environment.

The Two Major Theater War concept, approved by the Chairman Joint Chiefs of Staff, guides decisions on readiness force structure. This is one way of looking at how many Civil Engineers we will need. This will include basically four teams; lead teams, follow teams, roundout teams, and destination unique teams. All of these teams are comprised of Prime Base Engineer Emergency Force (BEEF) personnel, except for the destination unique teams. These teams are made up of RED HORSE and Prime BEEF personnel. This minimum manning is calculated and divided among Active Duty, Air Force Reserve, and Air National Guard. This final number of Active Duty is then used as the target manning level after outsourcing. People being replaced by contracts are given the option to retire, separate, or cross train into another career field.

This may not be the only way to look at this problem. With the Civil Engineer's dual role, training may need to be taken into account. The two major theater war concept can provide a concise number of required military personnel, but this may not be the best way to approach wartime manning.

Training is something Civil Engineers do every day. They are constantly training as they complete their peacetime tasks of infrastructure maintenance. They learn how to repair a water distribution line as they do it. A civilian contractor can do this task, but how does the military plumber learn how to do it in a bed down operation of a bare base?

There are many different skills represented in a Civil Engineer Squadron. Most of these skills play a vital role in both the peacetime and wartime maintenance of Air Force infrastructures. Career fields acquire wartime training to varying degrees while completing peacetime tasks. Each discipline benefits differently from their respective peacetime tasks. Some can relate much of their peacetime experiences directly to their wartime missions. Others must seek additional training to learn the skills needed for war because their daily peacetime tasks are not similar to their wartime tasks. This should be analyzed to determine if and how outsourcing affects the wartime readiness of each career field.

The main focus of this thesis is to explore an alternative approach to determining minimum wartime manning, with attention to overall readiness. Outsourcing, as opposed to privatization, will be the only means of manning level control considered. This is because outsourcing is the military's main focus to reduce manning levels. A system dynamics approach will be used to investigate better ways to determine how many craftsmen, and in what disciplines, Air Force Civil Engineers need to complete the task of

training in addition to providing wartime commitments. There is a number, probably smaller than our current manning but not necessarily as low as the minimum number required for a two major theater war, that optimizes capability and cost. Viewing this situation as a system is the only way to see the dynamics of the ever-changing amounts of fully trained craftsmen. Attrition rates and training efficiencies from peacetime operations and specialized wartime training must be viewed dynamically to provide an optimal analysis.

Research Questions

1. What peacetime Civil Engineer activities or skills are essential to the wartime mission?

2. What is the value of peacetime work orders in enhancing readiness for wartime requirements for each of these skills?

3. How does the policy-maker's value of readiness effect the future trends of outsourcing policy?

Chapter 2
Literature Review

As stated in the introduction, outsourcing is defined as transferring the performance of a function previously accomplished in-house to an outside provider. In the case of the military, government civilian employees can be considered outside providers. This activity is performed both in the Air Force and civilian industry. Many philosophies exist on the proper way to implement the practice and the motivations behind them. The Department of Defense and the Air Force have policy directing the use of Outsourcing and Privatization.

To better understand outsourcing, one must first understand the subject of core competencies. To be competent in something, an organization is well qualified or capable of performing the task. The term "core" can be described as the inner most important part or heart. "'Core' equals 'key' or 'critical' or 'fundamental.'" (Quinn, 1994:44) Core competencies are the set of specialized skills and knowledge that a company possesses to provide unique value to their customers. They are often the company's identity. Everything else could be outsourced away. As Quinn describes, its " 'sticking to your knitting' by cutting back to fewer product lines." (Quinn, 1994:44)

Handy depicts a "shamrock" organization in his 1990 book, *The Age of Unreason.* A shamrock is a small cloverlike plant with three leaves. Each of the leaves represents a different group of people in an organization. The first leaf symbolizes the professional core workers. He states, "it is increasingly made up of qualified professionals, technicians, and managers. These are people who are essential to the organization." (Handy, 1989:90) They are hard to replace and if you lose them, the organization will

severely suffer or may even fail. They usually have high salaries and good benefits, but in return they work long hours, giving many more than 40 hours a week to the company.

The second leaf is all nonessential work that is or can be supported by outside contractors. The best example of this is the cleaning staff. It is not essential that office space is cleaned by company professionals that give special identity to the organization. "All nonessential work, work which could be done by someone else, is therefore sensibly contracted out to people who make a specialty of it and who should … be able to do it better for less cost." (Handy, 1989:92)

The third and final leaf is the flexible labor force. These are the part-time and temporary workers that fill in when the need arises. Handy says this workforce is "the fastest growing part of the employment scene." (Handy, 1989:93) The reasons lie with changing customer demands, stores staying open longer, people traveling by air more in the summer, holidays placing heavier burdens on scheduling employees, etc. It could be possible to accommodate these peak periods with full time, essential personnel, but the demand for them is only high for a short period of time and they wouldn't be utilized the rest of the time. Also, the cost of hiring a full time employee with benefits and a salary is much more expensive than hiring part time help when they are needed.

Handy does not say that the shamrock organization is a new philosophy. Builders, farmers, and newspapers have operated this way for decades. As pointed out by Sharpe, "Handy was the first to suggest that this form of organization was, and would continue to be, embraced increasingly by a growing number of businesses of all types, as well as public sector institutions." (Sharpe, 1997:540) Handy's shamrock organization

theory came out about the same time companies were turning to outsourcing to meet competitive pressures to improve quality and lower cost.

Peter Drucker first coined the term "knowledge worker" in 1959. It is what the modern society worker is transforming into. A knowledge worker is required to have more higher level education than the traditional (blue-collar) worker. Their pay is as good as or better than the blue-collar's pay ever was and Drucker states that they will "amount to a third or more of the workforce in the United States." (Drucker, 1995:226)

Blue-collar workers mostly learned their trades from a short apprenticeship. Everything they needed to know for their entire career could be learned in a matter of a few years. This manual work was highly experienced based, whereas knowledge work is learning based. It requires formal education to learn, but offers much greater opportunities for the individual.

Drucker continues by saying "knowledge workers ... will, by definition, be specialized. Knowledge in application is effective only when it is specialized." (Drucker, 1995:238) This specialization has a great deal to do with the knowledge worker supporting outsourcing. Companies turn entire functions over to other organizations that specialize in that kind of work. Good examples of work outsourced are maintenance and housekeeping activities. Increasingly, companies are outsourcing data processing and business management functions. Companies choose to specialize in other work and pass these responsibilities over to independent contractors. On March 13,1995, IBM announce the formation of Network Station Management. This company was to "purchase maintain, and manage the many thousands of Personal Computers (PCs) in large companies." (Drucker, 1995:68)

This philosophy is growing continuously throughout the United States and other countries. Many people may soon find themselves not employed by the same company, but by an outsourcing contractor that specializes in those particular workers' skills. Drucker states, "In another ten or fifteen years, organizations may have outsourced all work that is 'support' rather than 'revenue producing' and all activities that do not offer career opportunities into senior management." (Drucker, 1995:68) The revenue producing activities would be the core competencies of the company. Outsourcing activities to companies that have their own senior management will increase productivity. "The trend towards outsourcing has very little to do with economizing and a great deal to do with quality." (Drucker, 1995:3)

Quinn and Hilmer, through careful study of successful and unsuccessful corporate examples, came up with seven characteristics of effective core competencies. They should be:

1) "Skill or knowledge sets, not products or functions." (Quinn, 1994:45) Traditional companies were formed in the past by concentrating on the basics of production, engineering, and sales. Executives need to look beyond those functions, to the intellectual skills or management systems of their companies. Competencies are sets of skills that are pervasive across all aspects of traditional functions. "This interaction allows the organization to consistently perform an activity better than functional competitors and to continually improve on the activities as markets, technology, and competition evolve." Competitive edge is achieved here. This is having an advantage over other companies in the same market, attracting and keeping customers. This is

usually achieved by performing cheaper, better, in a more timely fashion, or by providing some unique value to the customer on a continuing basis.

2) "Flexible, long-term platforms – capable of adaptation or evolution." This means, companies should not focus too narrowly on competencies at which they currently excel. Over time, companies need to continuously reassess customer needs and be flexible enough to react to them. A challenge would be to concentrate on skills that will be valued by customers for a long period of time.

3) "Limited in number." (Quinn, 1994:45) The number of core competencies a company has should be limited to less than five, but targeted at one or two. Each core competency requires intensity and management focus. If the number of core competencies gets too high then the company cannot focus on them as well as a more focused competitor. Managers find that they can not be best in everything, so they must limit their strengths. A good example is the Microsoft Corporation. It would be strategically hazardous for them to take their enthusiasm away from software development and focus on chip design. It would be unlikely they could compete well with Intel, and their software stronghold may weaken as other more focused companies enter the market.

4) "Unique sources of leverage in the value chain." (Quinn, 1994:45) These are areas where there are gaps in knowledge or market imperfections. A company that is uniquely qualified to fill these spots, gains intellectual advantages and profitability. A company that focuses on mass production of a product may fail as its competitors pass it by, finding new products which were missed.

5) "Areas where the company can dominate." (Quinn, 1994:45) Basically what this means is know what you can do really well, and do it. Outsource all of the tasks that can be done better by other companies, to those companies. Quinn states that outside suppliers, "by specializing in the specific skills and technologies underlying a single element in the value chain, can become more proficient at that activity than virtually any company spreading its efforts over the whole value chain." (Quinn, 1994:46)

6) "Elements important to customers in the long run." (Quinn, 1994:46) The company must keep the customers' needs in mind. One or more of their core competencies must be aimed at understanding and serving the customer.

7) "Embedded in the organization's systems." (Quinn, 1994:47) The creativity a company possesses must be transformed into a corporate reputation. Often, when a company has high creativity or skills, you can find that it is relying on one or two individual performers. If these "stars" decide to leave, the company may fail. Transforming creativity into corporate reputation can be done by broadly defining the companies core competencies to include, "its values, organization structures, and management systems."

There are several benefits to outsourcing discussed by Murem Sharpe. Outsourcing enhances a core competency business strategy. Companies are encouraged to outsource many of the largely routine, mundane tasks, and focus on the competencies that identify them. A few examples are the mail room, copy center, records, supplies, etc.

Companies who outsource can avoid exposing themselves to some unnecessary risks. As Sharpe states, it "enables organizations to gain the benefits of state-of-the-art skills and technologies without investing directly in their development." (Sharpe,

1997:541) For example if a company takes on a new sophisticated logistics and software system, and the company does not specialize in those areas, it may be best to outsource this function to a smaller company that *does* specialize in software systems.

Sharpe continues, "Outsourcing enables organizations to gain access to individuals with specialized skills they might otherwise find both expensive and difficult to attract." (Sharpe, 1997:542) This point ties in with Peter Drucker's prediction that companies will outsource all activities that do not have career opportunities into senior management. The companies with increased career opportunities will be more inviting to highly skilled and talented people. For example, an accountant would not want to work for a furniture company balancing their books. The chances of his someday running the company are very small compared to those with his working at an accounting firm.

These have been the various opinions and observations of many individuals studying the civilian, corporate industry. The Air Force has recently adopted an outsourcing philosophy for reasons that may appear different.

It states in the Air Force Policy Directive 38-6, dated 1 Sep 97,

> "To support national security objectives in the most efficient and cost-effective way, the Air Force must concentrate on its resource investments and management focus in areas most directly related to accomplishing its core missions. For the Air Force to focus primarily on core missions, it must effectively select internal and external sources of mission capability and reengineer its organization and processes." (AFPD 38-6, 1997:1)

This Policy Directive says that the Air Force is going to develop and focus on its own core competencies. There are four principal goals of this philosophy; "sustain readiness, improve performance and quality by doing business more efficiently and cost-effectively, generate funds for force modernization, and focus personnel and resources on core Air Force missions." (AFPD 38-6, 1997:1) It explains that the main driver for the

Outsourcing & Privatization (O&P) Program is "the need to save substantial amounts of money." (AFPD 38-6, 1997:Attachment 4) In the focus on core activities, the directive says that the activities may be different depending on the Major Command. Also, the core activities can change over time.

The search for core competencies is not exactly what the Air Force appears to be doing. In the 31 March 1997 white paper, *Business Transformation*, the then Secretary of the Air Force, Dr. Sheila Widnall, states that we should be moving fast in this operation to outsource. She says, "Perhaps the greatest obstacle in pursuing outsourcing and privatization is our comfort with the old and familiar ways of doing business." She continues, "Unless we aggressively move beyond those with all the ingenuity at our command, we will not be able to capitalize on all the opportunities that await us." This exhibits the extreme political pressure the Air Force feels to charge into outsourcing and privatization.

Cassandra Davis, program manager at the Pentagon in the Civil Engineer Outsourcing and Privatization Office (AF/ILE), explains that the current drive to outsource Civil Engineers came from the Chief of Staff of the Air Force, General Ronald Fogleman, when he realized that an additional fighter unit was slated to be cut. He tasked his staff to come up with more savings from outsourcing and privatization. It was widely excepted that the Air Force should be able to save over $3 billion annually, by "aggressively streamlining." (USAF White Paper, 1997:15)

The Civil Engineer Outsourcing Strategy was developed in January 1997. It states that one of its objectives is to "Identify Civil Engineer candidates [to be outsourced] … and develop a program by 1 Jul 97." The way civilian outsourcing

philosophies are organized is to first identify your core competencies and begin to outsource from there. It is very important to first properly identifying your core competencies. If the search for ways to outsource takes precedence, it could be possible to outsource a core competency.

The first assumption in Civil Engineer Outsourcing Strategy is that they will continue to support wartime missions. It goes on to say, "Military positions required for tasked overseas deployable civil engineer unit type codes (UTCs) and for base sustainment will not be cost compared (or outsourced)." This sounds good, but according to Maj Greg Cummings at the Air Force Civil Engineer Support Agency (AFCESA), they are responding to requests from the Pentagon (AF/ILE) to provide a 1998 update of the total force blue-suit engineers needed for two major theater wars. As confirmed by a discussion with Ms. Cassandra Davis, the Air Force Civil Engineers are outsourcing down to this number. This is not just outsourcing the non-core competencies. It is a reduction of all career fields in order to lower costs by outsourcing anything over the minimum numbers.

The Office of Management and Budget (OMB) Circular No. A-76 spells out Federal policy for outsourcing, privatization, and cost comparisons. The first thing this circular states is that "inherently governmental activities are not subject." (A-76, 1996:3) It clarifies by saying, "an inherently governmental activity is one that is so intimately related to the exercise of the public interest as to mandate performance by Federal employees." (A-76, 1996:3) An example of this would be any activity performed exclusively by military personnel as part of deployment in a combat, combat support, or combat service support role. (A-76, 1996:3) The study continues by defining military

essential to be "positions that directly contribute to the prosecution of war, exercise Uniform Code of Military Justice authority, are required by law, are military due to custom or tradition, are needed for overseas rotations, or require a skill not available in civilian resources." (A-76, 1996,3)

Outsourcing in Air Force Civil Engineering, then, is guided by the definition of "military essential" and by the minimum manning level required to conduct a two theater war. The Air Force may have more opportunities for optimizing outsourcing strategy by focusing core competencies in a manner more like the private sector.

In the Fall of 1996, the Air Staff sent out a tasking to the Major Commands (MAJCOM) to survey their organizations and identify possibilities for outsourcing and privatization. They were to list all tasks being completed on their bases and organize them into three categories. The categories were 1) those which can be outsourced easily with little or no mission effects (the "cans") 2) those which can be outsourced if some changes were made to organizational structure (the "coulds") and 3) those which can not possibly be outsourced (the "Can'ts"). This information was used by Air Force Civil Engineering (AFCE) to determine to what extent possible outsourcing can be implemented.

During the analysis of this report the country experienced its 2nd Quadrennial Defense Review (QDR). The first QDR was in 1992 when the wall dividing East and West Germany was dismantled and the United States wanted to look at changing its military mission philosophies and objectives. The second QDR agreed with the first in which the military should be strong enough and able to sustain a simultaneous two-theater war.

During the Summer of 1997, General Ronald Fogleman issued a directive to the MAJCOMs that they must execute outsourcing all "cans" and "coulds." This was briefed to and approved by the Air Force Council in October 1997 and put into the POM for the 1999 budget. This created some dissention among the MAJCOMs because what was once a simple study to find out possible savings was now a directive to execute.

After several reiterations of this, DRID 20 was introduced. DRID 20 says that every position in the Air Force will have an additional letter code added to it. These codes will tell if the position is war-fighting or not. Those that are not, can be outsourced. This information was just coming in during the completion of this thesis and the initial assessment indicates there is not enough candidates to reach Secretary Cohan's goal of 17 thousand additional positions to be outsourced.

According to Cassandra Davis (AF/ILE), eventually there will be blue bases and white bases in the Air Force. A white base is where everything is outsourced. A blue base is where everything remains as it was with military. Certain positions will be outsourced at both blue and white bases. An example of these positions is the Housing Flight. It will be outsourced at every base.

Chapter 3
Methodology

Outsourcing in the Air Force, specifically Civil Engineering disciplines, needs to be studied to view possible long-term outcomes as determined by strategic outsourcing policies. A systems dynamics approach will be utilized.

A system dynamics model describes cause-and-effect relationships and the manner in which the effects loop back to influence the causes. The system being studied here is the cause and effect factors which determine the variable manning number for each career field within civil engineer squadrons. To begin understanding the system, an influence diagram is developed.

In the initial influence diagram in Figure 1, each circle is a factor in the system. The factor labeled "Current Military Authorizations" is the number of positions in each career field at an instant in time. The arrows from one factor to another represent the causal relationship that one has on the other. If the change is positive there is a plus sign (+) drawn near the arrowhead. This reads "if the first item goes up, the second item goes up." If the change is negative there is a minus sign (-) drawn near the arrowhead. This reads "if the first item goes up, the second item goes down." For instance, as Current Military Authorizations goes up, Readiness goes up and as Readiness goes up, this creates a comfortable feeling among decision-makers that we are prepared for war. This causes them not to worry about outsourcing capability and Outsource tasks goes up. The basic assumption is that outsourcing saves money by reducing authorizations.

Some of the factors in this influence diagram need to be studied and parameterized before the system dynamics research can continue. The wartime

correlation number is the percentage of the peacetime activities that are the same as in the wartime mission. This will tell how much training the career field is achieving during the completion of everyday peacetime tasks.

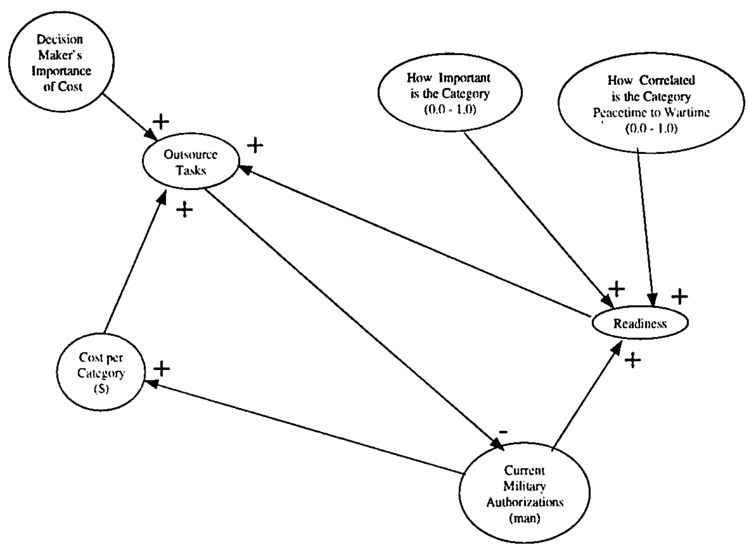

Figure 1. Influence Diagram of an Outsourcing Thought Process

Within the Air Force Civil Engineer career field there are several categories of skills. These categories are defined by the thirteen enlisted Air Force Specialty Codes (AFSC), listed in Table 1.

Within these categories there are many defining tasks. There are basically two different lists of tasks that are completed by the particular AFSC. A peacetime list of tasks can be found in the Career Field Education and Training Plans (CFETP) and a wartime list of tasks can be found in the Contingency Training Guide and Task Standard (AFPAM 10-219, Vol 10)

AFSC 3E0X1	Electrical Systems
AFSC 3E0X2	Electrical Power Production
AFSC 3E1X1	Heating, Ventilating, Air Conditioning, and Refrigeration (HVAC)
AFSC 3E2X1	Pavements and Construction Equipment Operator (P&E)
AFSC 3E3X1	Structural
AFSC 3E4X1	Utilities Systems
AFSC 3E4X2	Liquid Fuels Systems Maintenance
AFSC 3E4X3	Environmental
AFSC 3E5X1	Engineering
AFSC 3E6X1	Operations
AFSC 3E7X1	Fire Protection
AFSC 3E8X1	Explosive Ordinance Disposal (EOD)
AFSC 3E9X1	Readiness

Table 1. Air Force Specialty Codes (AFSC)

In order to determine how much value is added to wartime training by the completion of peacetime work orders, a relationship between the two must be made. Because the peacetime mission is the one vulnerable to outsourcing, it will be studied to determine how related it is to the wartime mission. Within each category, or AFSC, there is a list of tasks. The peacetime list will be compared to the wartime list to determine the percentage of peacetime tasks that are the same or very similar to one or more of the wartime tasks. If a peacetime task had a match in the list of wartime tasks then it was considered a "success." This operation will be repeated for each category until all skills have been evaluated.

The peacetime and the wartime documents were written at different times and were not written to be compatible. Some of the peacetime tasks will need to be broken down into separate homogeneous tasks. After all of the wartime tasks have been considered, the remaining tasks that did not have a match will be considered a "failure."

Each AFSC will have a certain number of successes and a certain number of failures. The successes divided by the total will give a percentage or wartime correlation number. This number can be used in the model to give value to the AFSC when considering outsourcing.

Another factor in the influence diagram that needs to be parameterized is the importance of the AFSC. The importance or value of the AFSC's wartime mission is also useful when determining outsourcing the AFSC. This value of the AFSC's wartime mission will be computed on a scale of 0.0 to 1.0. The lowest importance score will have a value of zero, and the highest importance score will have a value of one.

The AFSCs are not rank ordered by wartime importance by the Air Force. The only documentation that comes close to an importance ranking is found in the Bare Base Conceptual Planning Guide (AFPAM 10-219, vol. 5, Section 3.7). This section is called Task Priorities and is basically a list of the wartime tasks divided into four task lists: Priorities 1, 2, 3, and 4. This list can be found in Appendix A. There are 18 tasks in Priority 1, 14 tasks in Priority 2, 13 tasks in Priority 3, and 6 tasks in Priority 4. Each of these tasks can then be associated with an AFSC and used to evaluate them.

To establish a higher order ranking or wartime task importance value, a multi-objective value analysis will be conducted. This will produce a more precise way to evaluate tasks by wartime importance. As discussed by Kirkwood, "To conduct a multi-objective value analysis, it is necessary to determine a value function, which combines the multiple evaluation measures into a single measure of overall value." (Kirkwood, 1997:53) Each task in the priority list will be assigned two single dimensional value factors, one for *Characteristic Indicator* or *I* and one for *Priority* or *P*. These two

individual evaluation measures are then combined in a multi-objective value function to yield an importance factor or value, V. The function will look like: $\mathbf{V = w_1{*}I + w_2{*}P}$, where w_1 and w_2 represent the weights assigned to importance and priority or Air Force doctrine respectively. "The form of this function . . . is a weighted sum of functions over each individual evaluation measure." (Kirkwood, 1997:52) In this case, two single dimensional value functions need to be specified for I and P.

The Importance single dimensional value function will be determined by, first, interviewing an expert in the field of Air Force Civil Engineer readiness. This interview will ferret out characteristics, which make a task important or unimportant. These characteristics will include things like mission, safety, and human sustainment. The characteristics will then be taken to a higher ranking Civil Engineer officer with wartime and peacetime expertise to act as a decision-maker. This decision-maker will then rank order the characteristics and then assign a relative importance weighting between 0.0 and 1.0. This ranking will create the single dimensional value function for Importance. Using this value function, each task can be assigned an Importance Factor due to the characteristics it holds.

The second single dimension objective is the Priority Factor. A single dimensional value function will need to be determined for this case too. Each Priority level (1, 2, 3, or 4) is assigned a relative value by the decision-maker. By running the tasks through this function, a value can be given to each task for priority level, within the Air Force doctrine. This value will be the priority factor.

Now, each of these single dimensional values (priority and importance) need to be put into the multi-objective value function. The question given to the decision-maker is

how much weight (w_1) does he put towards the importance factor (I) and how much weight (w_2) does he put towards the Air Force doctrine priority (P).

After these critical parameterizations are complete the system will be transformed into mathematical code. This will be achieved by use of the computer modeling software, STELLA. The system can be run over and over again, using slightly different parameters each time. This will be useful to run the model for each AFSC.

Testing of the model will need to be done during its evolution. The first of these tests is to find mechanical errors in the model. In order to do this the model needs to be run many times while paying close attention to how the variables are behaving over time.

The next series of tests are for robustness. These tests are completed by running the model with the full range of possible inputs. First, change single variables to their highest or lowest possible value. Then after those tests are running completely, begin to change entire sections of variables to the highest and lowest values and run. Finally, run the model with every variable in its extreme. A robust model will behave reasonably under feasible extreme conditions.

Once the model is determined to be running effectively, each AFSC's importance factors, war correlation factors and initial military authorization numbers will be input into the model and studied for a variety of policy-maker or decision-maker profiles. These profiles will include a decision-maker that considers cost over readiness at 0.6 to 0.4, a decision-maker that considers cost over readiness at 0.9 to 0.1, and a decision-maker that does not consider cost at all, only readiness.

This methodology for determining the importance of each task was not the first one attempted. The original design was to survey five Civil Engineer members

throughout the Air Force, considered to be experts in the field of readiness. The survey asked them to pick tasks out of each priority level that they deemed important. The number of tasks within each priority category determined the number of tasks they were allowed to pick. This determination was made to make it theoretically possible for every task to receive at least one pick. The survey participants were allowed to pick four tasks from priority category 1, three from priority category 2, three from priority category 3, and two from priority category 4.

Each of the tasks would receive a certain number of picks, ranging from zero to five. Tasks that received five picks were considered to be the most important tasks. Conversely, tasks that received zero picks were considered to be the least important tasks. The task list, including each corresponding number of picks, was then taken to the decision-maker. He determined the value of each number of picks to create the single dimensional value function for the importance factor.

This methodology was determined to be flawed on two major accounts. First, there is no value or importance given to the tasks that received zero picks. Every survey participant may agree that if they had one more pick they would have all chosen a certain task. That would cause that task to rise to the top of the list and be viewed as one of the most important. But, in actuality, the task received zero picks and is viewed as one of the least important.

Second, this methodology confined participants within each category. There was no way to judge or evaluate a task's relative importance across priority categories. A task viewed to be most important in priority category 2 could not be related to the importance of the least important in level 1.

Chapter 4
Discussion

The methodology of this thesis was discussed in Chapter 3. This chapter will follow the same logical patterns to disassemble the different components of the influence diagram, parameterize the items needed, and present the results of several executions of the model. First the model development will be explained.

According to the influence diagram, there are three main influences affecting the decision to outsource tasks. Two of them are Cost and Readiness. The other is how important cost is to the decision-maker. There are many different considerations a decision-maker needs to take into account when deciding how to form outsourcing policy. Each of these considerations needs to be weighted. This model only recognizes two considerations: cost and readiness. The model totals these factors at 100%, and the decision-maker places an importance on one item, but the more he favors that one, the less he can favor another. For example, if the decision-maker highly values cost, he may assign an 80% to cost. This would mean that readiness would be valued at a level of 20%.

Cost is defined in the model by multiplying the Current Military Authorizations by an estimate of the average cost of an enlisted member. This average cost is assumed to be $35,000 per year per person.

Readiness is basically composed of three elements: Current Military Authorizations, War Correlation Number and an Importance Factor. If an AFSC is outsourced, the peacetime mission is no longer being completed by military members.

The completion of these peacetime work orders has an impact on wartime readiness. There is training being completed along with the peacetime mission.

A comparison of wartime tasks and peacetime tasks was completed. The list of peacetime tasks can be found in Appendix A. As discussed in Chapter 3, if a peacetime task had a match with a wartime task, it was considered a success. The proportion of successes to failures is the wartime correlation number for that AFSC. The results are in Table 2.

	Success	Failure	Total	%
Electrical Systems	10	14	24	0.417
Power Production	18	14	32	0.563
HVAC and Refrigeration	12	10	22	0.545
P&E	13	7	20	0.650
Structural	6	9	15	0.400
Utilities	10	9	19	0.526
Liquid Fuels	4	10	14	0.286
Environmental	6	11	17	0.353
Engineering	17	6	23	0.739
Operations	8	15	23	0.348
Fire Protection	9	21	30	0.300
EOD	14	8	22	0.636
Readiness	21	11	32	0.656
	148	145	293	

Table 2. Wartime Correlation of Peacetime Tasks

After these results were recorded, a statistical test of homogeneity was performed and the results are in Table 3. The test of homogeneity determines whether or not the populations of successes and failures of each AFSC are the same or statistically significantly different. If the AFSC success/failure populations are homogeneous then the data should suggest they are not significantly different. The Chi-square test p-value of 0.016 suggests that the hypothesis of homogeneity can be rejected at a significance level of 0.05. Hence, one can infer the populations are not homogeneous.

CASE		SUCCESS	FAILURE	TOTAL
		VARIABLE		
1	OBSERVED	10	14	24
	EXPECTED	12.12	11.88	
	CELL CHI-SQ	0.37	0.38	
2	OBSERVED	18	14	32
	EXPECTED	16.16	15.84	
	CELL CHI-SQ	0.21	0.21	
3	OBSERVED	12	10	22
	EXPECTED	11.11	10.89	
	CELL CHI-SQ	0.07	0.07	
4	OBSERVED	13	7	20
	EXPECTED	10.10	9.90	
	CELL CHI-SQ	0.83	0.85	
5	OBSERVED	6	9	15
	EXPECTED	7.58	7.42	
	CELL CHI-SQ	0.33	0.33	
6	OBSERVED	10	9	19
	EXPECTED	9.60	9.40	
	CELL CHI-SQ	0.02	0.02	
7	OBSERVED	4	10	14
	EXPECTED	7.07	6.93	
	CELL CHI-SQ	1.33	1.36	
8	OBSERVED	6	11	17
	EXPECTED	8.59	8.41	
	CELL CHI-SQ	0.78	0.80	
9	OBSERVED	17	6	23
	EXPECTED	11.62	11.38	
	CELL CHI-SQ	2.49	2.55	
10	OBSERVED	8	15	23
	EXPECTED	11.62	11.38	
	CELL CHI-SQ	1.13	1.15	
11	OBSERVED	9	21	30
	EXPECTED	15.15	14.85	
	CELL CHI-SQ	2.50	2.55	
12	OBSERVED	14	8	22
	EXPECTED	11.11	10.89	
	CELL CHI-SQ	0.75	0.77	
13	OBSERVED	21	11	32
	EXPECTED	16.16	15.84	
	CELL CHI-SQ	1.45	1.48	
		148	145	293

OVERALL CHI-SQUARE	24.77
P-VALUE	0.0160
DEGREES OF FREEDOM	12

Table 3. Chi-Square Test For Heterogeneity or Independence

In the formula, p_{I1} represents the true proportion of each AFSC. To compute the estimated expected cell counts, $\hat{e}_{ij}$, the sums of i^{th} row totals and j^{th} column totals are input into the formula: $\hat{e}_{ij}$ = (i^{th} row total)*(j^{th} column total)/n, where n is the sum of the sample size. (Devore, 1995:608)

For this case shown in Table 3, the first $\hat{e}_{ij}$ is computed by taking the column total of 148, multiplying it by the row total of 24. Dividing this product by the sum of the sample size, 293, yields the estimate of 12.12. These parameters are then input into the formula in Figure 2 to give the Chi-Square statistic.

Null hypothesis: H_0: $p_{11} = p_{21} = \cdots = p_{I1}$
Alternative hypothesis: H_a: at least two of the p_{i1}'s are unequal
Test statistic value:

$$\chi^2 = \sum_{\text{all cells}} \frac{(\text{observed} - \text{estimated expected})^2}{\text{estimated expected}} = \sum_{i=1}^{I}\sum_{j=1}^{2}\frac{(n_{ij} - \hat{e}_{ij})^2}{\hat{e}_{ij}}$$

Rejection region: $\chi^2 \geq \chi^2_{\alpha,I-1}$

In practice, the test can safely be applied as long as $\hat{e}_{ij} \geq 5$ for every i, j (all cells).

Figure 2. Test for Homogeneity in I Dichotomous Populations

Now the Wartime Correlation Number is known, but in order to calculate Readiness, an Importance Factor also needs to be determined. An AFSC can be highly correlated with the wartime mission, but if it doesn't complete an "important" wartime mission, then it should not be considered of high value to readiness. Importance Factors are numbers between 0.0 and 1.0. The higher the number the higher the importance of that AFSC.

As discussed in Chapter 3, there is no Air Force documentation assigning importance to each AFSC. The closest is the list of task priorities in four different

categories of 1, 2, 3, and 4. This list is in Appendix A. This priority ranking, documented by the Air Force, is one attribute in finding the Importance Factor for each task. The other attribute needed to further differentiate the tasks from one another is based upon characteristics.

In order to assign a characteristic value to each of the tasks, Maj Gregory Cummings, Chief of Readiness, Air Force Civil Engineer Support Agency (AFCESA) was interviewed. Maj Cummings participated in the abandoned methodology discussed at the end of Chapter 3. He was one of the individuals who picked their top choices of importance. So, he was already familiar with the priority list.

During the interview, Maj Cummings was asked what were his thought processes when he was picking the tasks he believed to be important. We discussed what characteristics he saw associated with those particular tasks. Then we discussed the tasks others picked as important and what makes those more or less important than others. After these discussions were exhausted, we reviewed the tasks which no one picked. The fact that one of those tasks could have been everyone's next most important pick was entered into the interview. This caused those tasks to be looked at carefully and not just thrown out as trivial or unimportant. Then characteristics for these tasks were defined as well.

This developed a list of deciding characteristics at the task level, seen in Table 4. This list was taken to Col Joseph Amend III, who acted in the roll of a decision-maker by reviewing the list, prioritizing it, and then assigning relative values to each deciding characteristic.

Col Amend is the dean of the Civil Engineering and Services School, Air Force Institute of Technology. He has been a Civil Engineering Officer since his entry into active service in 1975. He has been Chief of Engineering Design, 554th Civil Engineering Squadron, Heavy Repair (RED HORSE), Osan AB, Korea; Deputy Chief of Staff for Engineering and Services, HQ Pacific Air Forces, Hickam AFB, Hawaii; Commander of the 379 Civil Engineering Squadron, Wurtsmith AFB, Michigan; Commander of the 89 Civil Engineer Squadron, Andrews AFB, Maryland.

Col Amend participated in the Granada Invasion in 1983 and through his two tours as a Base Civil Engineer, he has participated in many week long Operational Readiness Inspections (ORI). He has advised and deployed officers in his command to Desert Shield/Desert Storm. His philosophy is to minimize surprises or to be prepared for the worst, but hope for the best.

Throughout the interview, Col Amend stated that Force Protection was at the top of the list because without this, the mission will fail. People are our greatest asset and their protection needs to be the utmost important. If their protection is not being accomplished, nothing can get done. Once you have the mission working, one can begin to pay attention to the basic needs of the people. This is time to help other organizations better accomplish their mission.

After things in the deployment begin to calm down, that's the time to start pushing safety. Make sure that we are not losing people to enemy fire then make sure we are not losing them to mishaps. Then we can start to focus in on Quality of Life and Long Term Issues. The prioritized characteristic list is at Table 4 and it translates into the

single dimension value function shown in Figure 3. This establishes a value for each task, across categories.

Deciding Characteristic Ranking	Deciding Characteristics	Value
1	Force Protection	1.00
2	Mission	0.99
3	Human Sustainment	0.90
4	Combat Support	0.80
5	Safety	0.79
6	Operated Critical Facilities	0.75
7	Mission Enhancement	0.50
8	Quality of Life	0.45
9	Long Term Bed Down and Mission	0.30
10	Long Term Safety	0.22
11	Long Term Human Sustainment	0.14
12	Long Term Combat Support	0.07
13	Long Term Quality of Life	0.00

Table 4. Deciding Characteristics

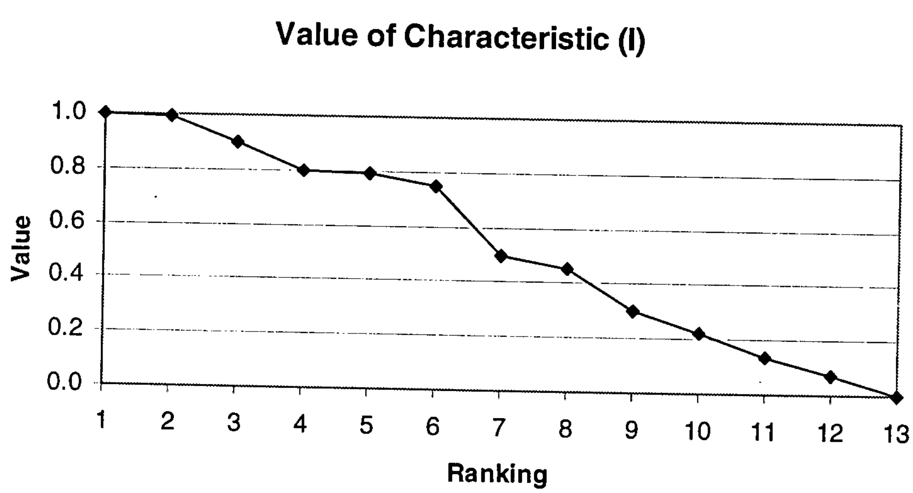

Figure 3. Single Dimension Value Function for Deciding Characteristics

Col Amend was asked to assign relative values to the four different priority numbers to create the second single dimension value function for the Air Force Priority Categories. After reviewing the priority list, the value function or Value of Priority was created. He assessed that the relative value of each priority increases exponentially as the priority level increases from category four to one. This is seen in Figure 4 below.

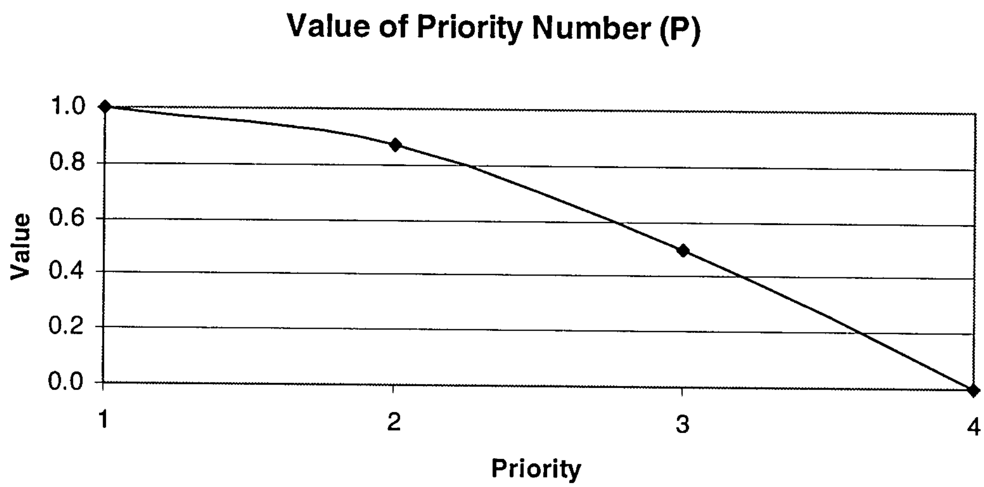

Figure 4. Single Dimension Value Function for Air Force Priorities

These two values are then input into the multi-objective function discussed in Chapter 3, $\mathbf{V = w_1*I + w_2*P}$. According to Col Amend, this Priority list that Air Force Civil Engineers put together, is roughly two-thirds more important than the Characteristic Function because there was a lot more time and effort put into it. Many more experts were involved in that exercise and it deserves more weight. His feelings were that the characteristic value determination was an interesting way of approaching a solution, but it is very subjective in nature and small changes in his priorities or assignment of relative values could change the overall results. The Priority list is generic enough to be a great starting point when preparing for an unknown situation. He decided on a weighting scale

of 60% to the Air Force Priorities and 40% to the characteristic value. These weights now are placed into the multi-attribute utility function to gain the formula: **0.4 * I + 0.6 * P = V.**

Each task is now associated with a characteristic. It is not possible for a task to be associated with more than one characteristic because the characteristics were originally defined by specific tasks. Maj Cummings and myself made these associations during our interview. Each task can be run through the value function for Deciding Characteristics and get a number between 0.0 and 1.0. In addition, each task can be run through the value function for Priorities and get another number between 0.0 and 1.0. These numbers are then input into the multi-objective function (**0.4 * I + 0.6 * P = V**) to yield an overall importance number for each task.

Each of these tasks now can be assigned to an AFSC, specifically the AFSC that completes the task in wartime. Each task can have multiple AFSCs assigned to it, because different career fields complete many tasks. To compute the AFSC Importance Factor, all of the respective individual task values were averaged. This was done because of two assumptions. One, the wartime tasks completed by a certain AFSC are not limited to just the tasks found on the priority list. The actual tasks the AFSC will perform in a wartime situation may not all be on the priority list. Two, if a task not on the list is being completed, the task is going to be roughly the same importance level as the rest of the tasks. So, AFSC Importance Factor will not change. Individual AFSCs do not receive benefits by having more tasks on their list.

Now that these importance factors have been parameterized, the model has more meaning. Current Military Authorizations is defined as a stock, which is an entity that

can grow and decrease unbounded. In this case, the stock is bounded by zero. The amount in the stock is determined only by flows in and out. Current Military Authorizations has one flow, as seen in Figure 5.

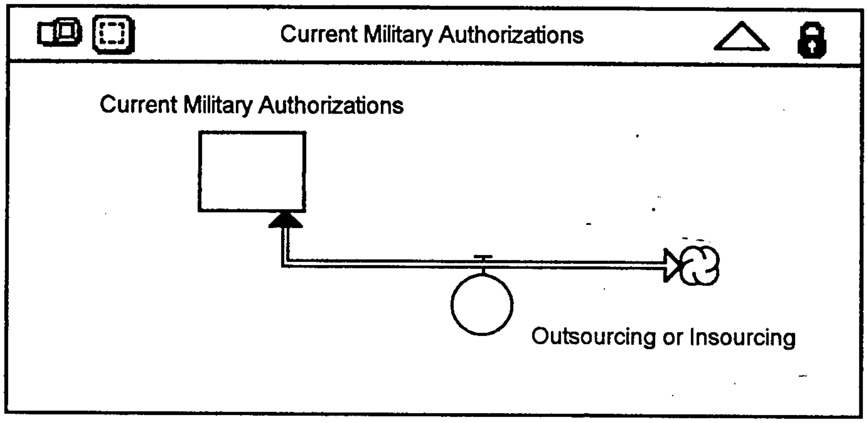

Figure 5. Current Military Authorizations Stock in the Model

Notice that Outsourcing or Insourcing is a bi-flow, meaning that it can add to or take away from the stock. This flow is defined by many different competing factors and this struggle is what determines the trends of the levels of military manning. The formula for the flow in and out of Current Military Authorizations is shown in Figure 6.

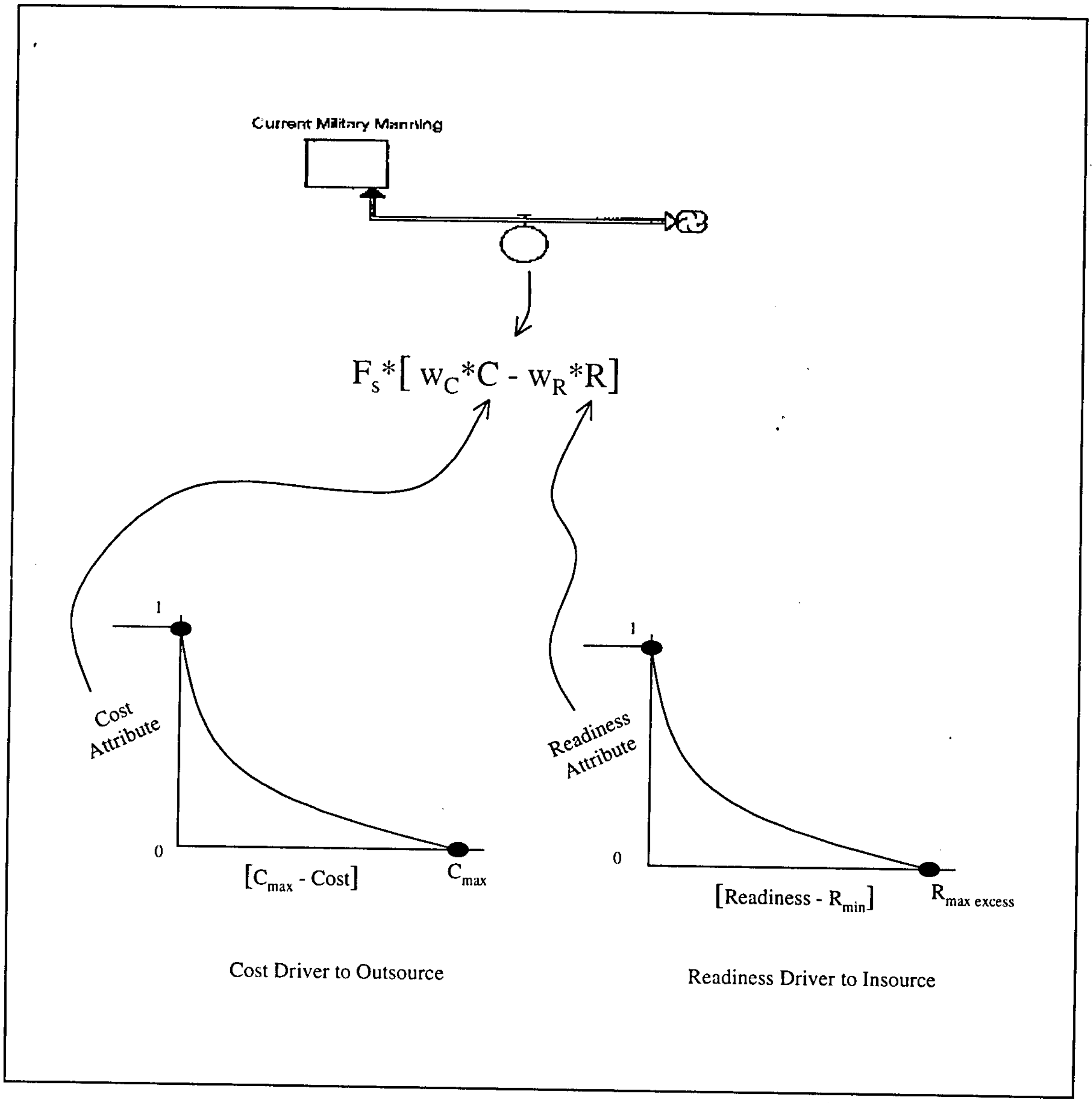

Figure 6. Attribute Explanation

The formula is depicted just below the flow in the Figure 6. F_s is defined as 5% of the current manning level. This is the maximum amount of sourcing the system can administratively handle. This can be changed if the decision-maker believes the personnel system of the Air Force can handle more or less.

The two competing factors for authorization flow are Cost and Readiness. Cost is defined as the current military authorizations multiplied by \$35,000. \$35,000 is a constant throughout the model and is a rough estimate of the average cost of an enlisted member. Readiness is defined by current military authorizations multiplied by the risk factor (between 0.0 and 1.0). The Cost Attribute and the Readiness Attribute are the decision-maker's drive to outsource or insource. Cost drives outsourcing and Readiness drives insourcing. These attributes are defined by the two graphs shown in Figure 6. C_{max} is defined by the decision-maker and is the highest level of cost he is willing to accept. Whenever cost is equal to or higher than C_{max}, the cost driver is at its maximum value of 1.0. Conversely, if cost equals zero then the cost drive is zero, but when the cost is somewhere between, the drive to outsource is defined by the curve. This cost drive is defined by current cost and has nothing to do with the decision-maker weightings. The decision-maker assigns the weights, w_C and w_R, and this is how much he takes the attributes into consideration during the outsourcing process.

The Readiness Attribute is the drive to insource due to readiness. Once again, it is defined by current readiness levels and has nothing to do with the decision-maker weightings. R_{min} is the minimum readiness level the decision-maker will tolerate and $R_{max\ excess}$ is the readiness level which results in no drive to insource due to readiness. The Readiness Driver to Insource graph shows that if readiness equals R_{min} then the Readiness Attribute is 1.0. The Readiness Attribute is the drive to insource due to readiness.

The flow diagram of this model is shown in Figure 7, and the expanded mathematical code is in Appendix B.

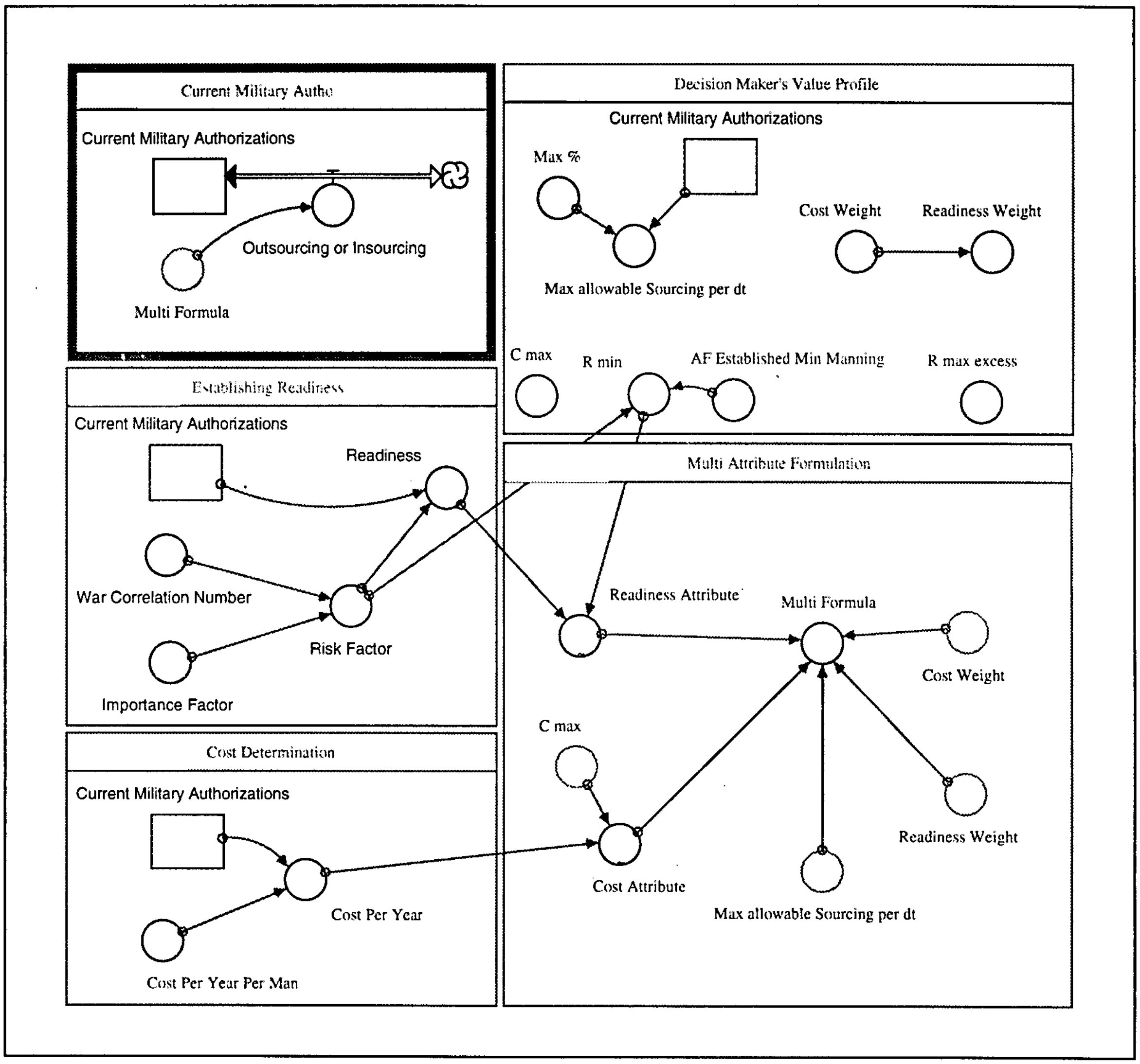

Figure 7. Flow Diagram of the Model

In order to run this model, eight variables must be entered. Table 5 shows the initial input values for each of the required parameters. Several assumptions were made here, but can be easily changed to suit a new decision-maker in the program preferences. $R_{max\ excess}$ is calculated as 3 times whatever readiness level the two-theater war concept

defines. These numbers are arbitrary and can be changed for different decision-maker profiles. C_{max} is the cost at the initial situation. This assumes that the current situation is already driving us towards outsourcing with a cost driver at the maximum value of 1.0. These assumptions may not be the most accepted, but this is just a starting point and the model can be easily set up to run different initial conditions. The Importance Factor and War Correlation Number are defined by the parameterization process explained previously. The Current Military Authorizations is the number of allocations each AFSC currently possesses, and the Air Force Established Minimum Manning is the number of

AFSC	Current Military Authorizations	Air Force Established Military Manning	War Correlation Number	Importance Factor	Cost per Man	C max	R max excess
3E0X1	1948	1499	0.417	0.662	$35,000	$68,180,000	2425
3E0X2	1360	1432	0.563	0.583	$35,000	$47,600,000	2461
3E1X1	2201	1452	0.545	0.414	$35,000	$77,035;000	2089
3E2X1	1852	1593	0.650	0.692	$35,000	$64,820,000	3206
3E3X1	1822	1522	0.400	0.579	$35,000	$63,770,000	2235
3E4X1	1724	1423	0.526	0.606	$35,000	$60,340,000	2415
3E4X2	295	229	0.286	0.682	$35,000	$10,325,000	332
3E4X3	278	185	0.353	0.693	$35,000	$9,730,000	290
3E5X1	1124	767	0.739	0.778	$35,000	$39,340,000	1745
3E6X1	463	402	0.348	0.461	$35,000	$16,205,000	488
3E7X1	3709	2598	0.300	0.866	$35,000	$129,815,000	4544
3E8X1	870	924	0.636	0.722	$35,000	$30,450,000	1883
3E9X1	654	564	0.656	0.589	$35,000	$22,890,000	1053

Table 5. Model Input Examples

authorizations required under the two-theater war concept. The manning numbers and the cost per man numbers were attained from Maj Greg Cummings, Chief of Readiness, AFCESA.

The first run is shown at Figure 8. The terms manning and authorizations are used interchangeably because this model does not attempt to follow overages and shortfalls. The manning levels are assumed to be at their current authorized levels. The user preferences are set at 0.6 for cost and 0.4 for readiness. The Cost Attribute starts out at around 1.0 then as manning levels go down, cost levels go down as well. This causes the Cost Attribute to begin to fall and it starts to level off as manning begins to level off in the out years. The Readiness Attribute begins at about 0.5 and goes up as manning level goes down. This makes sense, because the readiness level goes down as manning goes down, thus causing a greater drive to insource. Note that there are drastic changes in the first few years and as time goes by, everything levels off, eventually reaching a steady state condition.

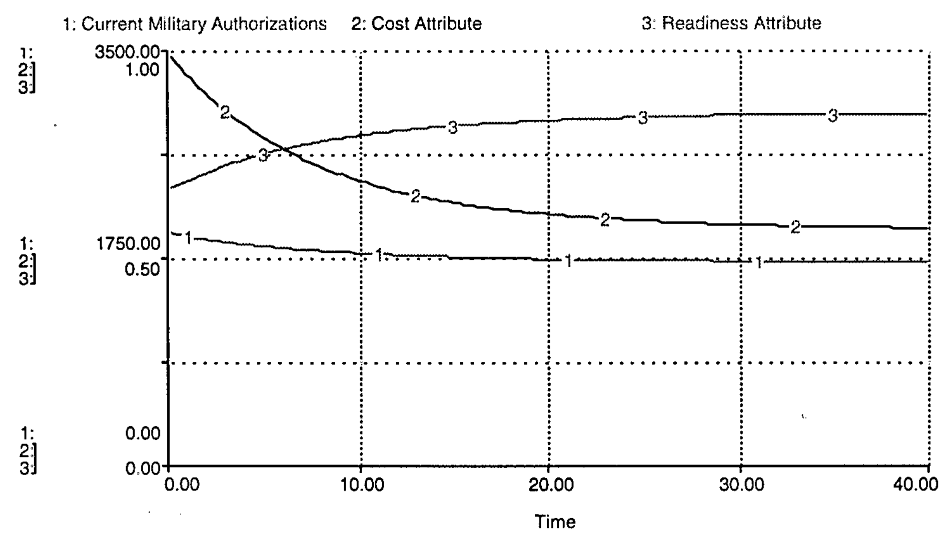

Figure 8. User Profile Set At 0.6 for Cost and 0.4 for Readiness

Now, let's suppose the decision-maker favors cost even more than 60%. The graph in Figure 9 shows a cost preference at 0.9 (0.1 for readiness). There are noticeable differences from Figure 8. There is a rapid drop in manning in the first few years. This

causes the rapid drop in the Cost Attribute and the rise in the Readiness Attribute. At around year 15 the Readiness Attribute reaches its maximum at 1.0. This is the highest the Readiness Attribute can get, but little insourcing is being done because the decision-maker's preferences place only a 10% on the Readiness Attribute. So the model is favoring the Cost Attribute and continuing to outsource. Once again, as manning is reduced, cost goes down which causes the Cost Attribute to go down. The rate of change is decreasing, but the manning level is still continuing to go down.

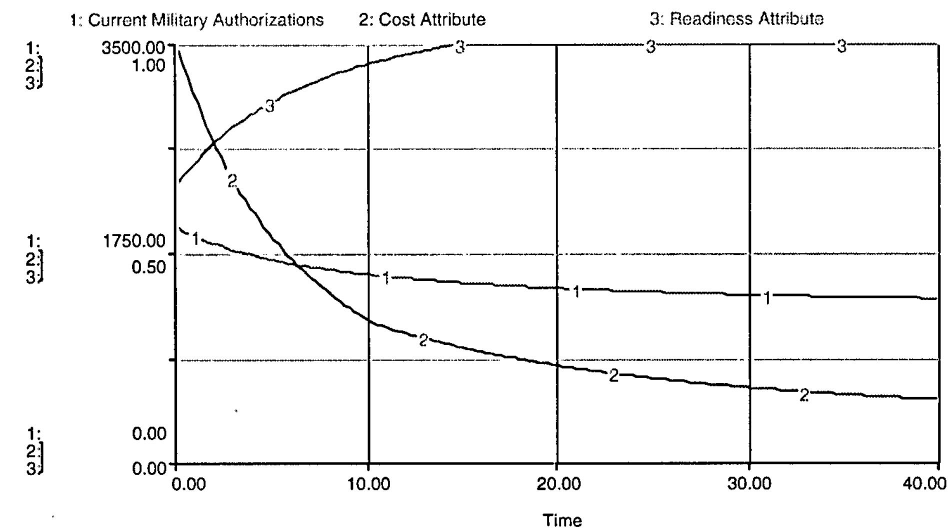

Figure 9. User Profile Set At 0.9 for Cost and 0.1 for Readiness

The graph in Figure 10 is a decision-maker profile of zero for cost and 1.0 for readiness. This means that whatever the Cost Attribute says, the model will only follow what is best for readiness and insource according to the Readiness Attribute. Manning

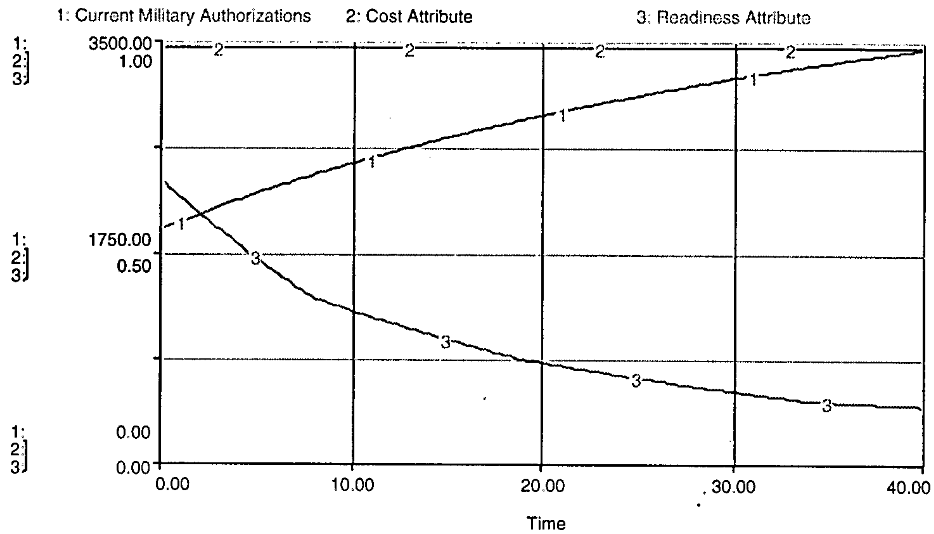

Figure 10. User Profile Set At 0.0 for Cost and 1.0 for Readiness

has increased off the graph even with the Cost Attribute pegged at its highest value of 1.0. The Readiness Attribute is reducing at a decreasing rate towards zero and will eventually reach it. At this point the manning level will stop increasing and level off.

Chapter 5
Conclusions

This thesis has illustrated an additional way to view the outsourcing policies of Air Force Civil Engineering (CE). The literature review explored and consolidated many different ways the civilian sector views outsourcing and how they employ it. The combination of different methodologies offered new possible research techniques. The in-depth study of the Air Force documentation brought out some unseen training opportunities. The evaluation of the Importance Factor and the Correlation Number for each one of the CE career fields can give insight to training plans and money allocations in addition to outsourcing strategies. The system dynamics study presented an original approach of viewing the process as a dynamic system in time.

The Air Force policy decision-makers on these outsourcing issues have to make choices between cost needs and readiness needs. They form their attitudes based on a great many things. The climate in which they work is a factor; the political pressures of the Air Force leadership and the political pressures of the United States affect the way they view the policy. The actions of foreign governments affect the political situation here in the U.S. All of these factors add to decision-makers' attitudes. They set the attitudes in motion and don't know the trends of future events.

Decision-makers have two competing objectives. They cannot disregard one or the other and the relationship may not be explicitly known. The overall objective has always been to maximize benefits. This model offers a way that the competing objectives can be studied and visually seen how they react to different inputs. It can be very helpful in seeing the future trends of cost and readiness. Observing the outcomes

may cause decision-makers to change their views and make decisions differently in order to provoke a more valuable long-term consequence.

The research questions posed earlier were:

1. What peacetime Civil Engineer activities or skills are essential to the wartime mission? The correlation number derived for each one of the Civil Engineer career fields shows the correlation of the peacetime tasks to the wartime mission. If this number is high, it means that that career field is doing almost the same tasks in peacetime as it would in wartime. The Importance Factor shows how valuable the career field is in a wartime situation. The tasks completed have characteristics that are now ranked and appraised in order of importance. These two factors combined offer a scale in which to judge the essentialness of each career field.

2. What is the value of peacetime work orders in enhancing readiness for wartime requirements for each of these skills? The wartime correlation number gives insight to this question. If a career field has a high correlation, the peacetime mission is a valuable asset that should not be overlooked. This number can be used to determine the training received from the peacetime mission that can directly effect the accomplishment of the wartime mission.

3. How does the policy-maker's value of readiness effect the future trends of outsourcing policy? This is where the model can offer insight into readiness and cost levels. Not only can the short-term consequences be observed, but the long term effects of changing parameters in attempts to optimize the system.

Some of the limits to this thesis are that the decision-maker in the model is limited to only two profile definitions, one of cost and one of readiness. There are many more

factors that go into determining a user profile than just these two. The thought processes that a decision-maker goes through to formulate outsourcing policy are very diverse and are not completely modeled here.

The political atmosphere is a large influence. This will tell the decision-maker whether or not funding for new weapon systems will be included in upcoming budgets. Many different things define the political atmosphere. Not only the political views of the President can define the atmosphere, but Congressmen, Secretaries, and even Generals in the Air Force can define it.

The weapon system that is driving the outsourcing can have a large impact on the views of the decision-maker. The decision-maker may see advantages or disadvantages to the new system, and they would effect the need to outsource.

One other big issue not addressed is the overall direction the Air Force is heading. There are stories of different concept ideas of total restructuring of Air Force assets. This would definitely redirect any policy made on outsourcing.

This study just begins to assist the decision-maker complete the job. It is a tool that addresses a small part of the overall problem. One still needs to take into account many more things.

Some recommendations for further study are to refine the model by adding more attributing profile characteristics than just the user's opinions on cost and readiness. There are many other defining profile characteristics that were not addressed in this thesis.

After the model has been refined, there are many different ways to study the model. Trends of manning, cost drivers, and readiness drivers are not the only variables

that could be interesting. One could study how the effects are comparably different from one career field to the next. The simulation can be stopped after a trajectory toward an undesired outcome is observed. Then the profile can be changed to effect a different outcome.

Different experts can replace the ones interviewed in this thesis. The interviews can be done with different participants. Perhaps actual decision-makers at Air Staff Headquarters can be interviewed. Both of the different decision-maker results can be compared to each other. Statistical testing can be employed to add validity to the interview results and prove them more substantially.

Appendix A
Peacetime Tasks For Each AFSC

3E0X1 Electrical Systems

1. Installs, maintains, and repairs electrical power distribution systems and components.

2. Climbs utility poles.

3. Operates special purpose vehicles and equipment (including line maintenance and high reach trucks).

4. Inspects power line poles for pest damage, deterioration, and loose hardware.

5. Inspects, tests, and services overhead line conductors, direct buried cables and those in underground ducts and conduits.

6. Troubleshoots malfunctions

7. Test air samples in manholes for dangerous concentrations of combustible or toxic gases and oxygen deficiency.

8. Inspects, maintains, and repairs fixed and portable airfield lighting.

9. Installs, maintains, and repairs cathodic protection and grounding systems.

10. Installs, maintains, and repairs grounding systems.

11. Installs, maintains, and repairs fire alarms, intrusion detection alarms, and traffic system controls.

12. Installs, maintains, and repairs electrical appliances.

13. Maintains proficiency in first aid (including cardiopulmonary resuscitation).

14. Maintains proficiency in pole top and manhole rescue.

15. Complies with safety and environmental regulations and practices.

16. Solves complex maintenance problems by studying layout drawings, wiring and schematic diagrams.

17. Uses meters, testing devices, indicators, and recorders to locate equipment, distribution, and motor controller malfunctions and faults.

18. Diagnoses malfunctions and recommends repair procedures.

19. Develops and establishes maintenance and operating procedures to ensure maximum efficiency.

20. Supervises and manages people and resources.

21. Performs facility surveys.

22. Surveys proposed work to determine resources requirements.

23. Prepares cost estimates for in-service work.

24. Applies engineered performance standards to plan and estimate jobs.

3E0X2 Electrical Power Production

1. Checks equipment for serviceability.
2. Positions equipment such generators and other power plant auxiliary equipment.
3. Modifies equipment according to technical publications.
4. Accomplishes operating and repair tasks.
5. Installs, positions, and tensions aircraft arresting systems.
6. Checks installed equipment to ensure.
7. Inspects, tests, and services components.
8. Observes and interprets instruments such as ammeters, voltmeters, and frequency meters.
9. Adjusts engine generator systems to maintain proper voltage, current frequency, and synchronization.
10. Performs electrical power and distribution functions.
11. Performs inspections, interprets inspection findings and determines corrective action.
12. Identifies and records engine and generator malfunctions.
13. Troubleshoots.
14. Uses precision test equipment.
15. Removes, repairs, and replaces defective power generating electrical components.
16. Performs corrosion control.
17. Inspects and replaces gauges and meters.
18. Maintains aircraft arresting systems.
19. Bench checks components and subassemblies.
20. Tests and calibrates repaired items.

21. Reviews performance data and maintenance records to determine adequacy of maintenance.

22. Solves maintenance problems.

23. Studies layout drawings and wiring and schematic diagrams.

24. Analyzes construction and operating characteristics.

25. Develops and establishes maintenance and operating procedures to ensure maximum efficiency.

26. Posts entries on operation, inspection, and maintenance records.

27. Records meter reading, wear and alignment measurements and fuel consumption.

28. Recommends changes to correct defective equipment or improve operating procedures.

29. Coordinates plans with other civil engineer and base activities.

30. Inspects work activities to ensure quality and compliance with policies, regulations, and other publications.

31. Complies with environmental policies.

32. Supervises and manages personnel and resources.

3E1X1 Heating, Ventilating, Air Conditioning, and Refrigeration

1. Interprets drawings and schematics
2. Installs HVAC/R components.
3. Installs, repairs, fabricates, and tests piping and tubing systems.
4. Installs and connects controls.
5. Tests HVAC/R equipment for proper operation.
6. Balances air and water in HVAC systems.
7. Monitors systems operations to ensure efficiency and compliance with technical orders.
8. Develops local procedures, handbooks, codes, and directives.
9. Evaluates industrial water treatment (IWT) for heating and cooling systems.
10. Ensures compliance with environmental regulations for fuels, refrigerants, and hazardous materials.
11. Performs recurring maintenance and seasonal overhaul on systems and components.
12. Uses drawings and schematics to analyze and isolate system malfunctions.
13. Troubleshoots malfunctions using technical orders, manufacturer's handbooks, local procedures, codes, and directives.
14. Repairs or replaces components.
15. Modifies equipment for specific missions or to increase efficiency.
16. Maintains tools and equipment.
17. Solves complex maintenance problems by studying layout drawings.
18. Develops and establishes operation and maintenance procedures to ensure maximum efficiency.
19. Surveys proposed work to determine resource requirements.
20. Prepares cost estimates for in-service work.

21. Applies engineered performance standards to plan and estimate jobs.

22. Coordinates plans and other activities with other civil engineer sections and other base agencies.

3E2X1 Pavements and Construction Equipment Operator

1. Takes soil, aggregate, asphalt, and concrete samples for laboratory tests.

2. Interprets construction drawings and surveys using information such as subgrade contours and grade alignment.

3. Inspects pavements for surface, base, and sub-base damage or defects.

4. Repairs damaged or defective areas by removing and replacing joint and crack sealing, surface overlays, and seal coats.

5. Determines equipment requirements for construction activities.

6. Uses approved methods to provide erosion control.

7. Operates concrete and asphalt batch, rock crushing, and fixed or mobile plants.

8. Operates various types of construction to finish grade, level, slope, compact, and perform other construction equipment operations.

9. Operates snow and ice removal equipment.

10. Applies chemicals and other ice control products.

11. Inspects, lubricates, and performs operator maintenance on construction and snow removal equipment.

12. Adjusts and changes attachments on equipment.

13. Connects and repairs wire rope rigging to cable operated equipment.

14. Schedules and coordinates equipment repair and servicing with the vehicle maintenance activity and other servicing facilities.

15. Investigates proposed work sites to determine resource requirements.

16. Prepares cost estimates for work requests.

17. Applies engineered performance standards to plan and estimate jobs.

18. Coordinates plans with other civil engineer and base activities.

19. Inspects work activities to ensure quality and compliance with policies, regulations, and other publications.

20. Places and sets off explosives used in quarries, demolition and clearing operations, base denial operations.

3E3X1 Structural

1. Surveys proposed work sites to determine material and labor requirements.

2. Prepares cost estimates.

3. Reviews structural work progress and coordinates changes in schedules.

4. Constructs and repairs footings, floors, slabs, foundations, walls, roofs, steps and doors.

5. Constructs and modifies buildings.

6. Prepares, applies, and finishes mortar, concrete, plaster, and stucco.

7. Fabricates, repairs, and installs metal parts and assemblies for utility systems and buildings.

8. Welds, brazes, and solders ferrous and nonferrous metals using oxyacetylene and arc welding processes.

9. Welds butt, lap, tee, and edge joints in all working positions.

10. Inspects, maintains, repairs and installs overhead, rollup, and, mechanical gates.

11. Installs forms and reinforcing material.

12. Applies protective coatings such as primer, stain, and sealant.

13. Troubleshoots, repairs, and installs locking devices such as keyed, combination, cipher, panic hardware, and pad locks.

14. Erects scaffolding and works from high reach ladders and mobile platforms.

15. Identifies and selects construction materials considering strength, moisture content, grade, mix, application procedures, and curing.

3E4X1 Utilities Systems

1. Monitors systems operations to ensure efficiency and compliance.
2. Monitors raw water supply to detect chemicals and biological contaminates.
3. Ensures compliance with safety and environmental regulations for hazardous materials.
4. Installs and operates field potable water, and wastewater treatment equipment.
5. Performs inspection, recurring maintenance, and seasonal overhaul on systems and components.
6. Troubleshoots malfunctions.
7. Uses drawings and schematics to analyze and isolate system malfunctions.
8. Removes, repairs, and replaces defective components.
9. Modifies equipment for specific missions or to increase efficiency.
10. Analyzes water for chemical and physical characteristics to determine water purification treatment methods.
11. Solves complex maintenance problems by studying layout drawings, wiring and schematic drawings.
12. Develops and establishes operation and maintenance procedures to ensure maximum efficiency.
13. Coordinates locations of field latrines and pits with engineering and medical staff.
14. Locates and determines quality and quantity of water sources.
15. Performs facility surveys.
16. Surveys proposed work to determine resource requirements.
17. Prepares cost estimates for in-service work.
18. Applies engineered performance standards to plan and estimate jobs.
19. Coordinates plans and other activities.

3E4X2 Liquid Fuels Systems Maintenance

1. Manages and modifies liquid fuel systems and components.

2. Checks components for operation, adjustment, pressures, and internal and external leaks under pressure.

3. Troubleshoots malfunctions.

4. Uses drawings and schematics to analyze and isolate malfunctions.

5. Inspects condition of grounding wires, clips, and grounding conductors for proper resistance.

6. Inspects for accumulation of explosive vapors in enclosed liquid fuel systems.

7. Modifies equipment for specific missions or to increase efficiency.

8. Performs recurring maintenance.

9. Solves complex maintenance problems by studying layout drawings, wiring and schematics, and by analyzing construction and operating characteristics.

10. Develops and establishes operation and maintenance procedures to ensure maximum efficiency.

11. Surveys proposed work to determine resource requirements.

12. Prepares cost estimates for in-service work.

13. Applies engineer performance standards to plan and estimate jobs.

14. Coordinates plans and other activities.

3E4X3 Environmental

1. Conducts pest management surveys.

2. Determines appropriate pest management actions to control and prevent infestation of plant and animal pests.

3. Interacts with medical activities to control health hazards.

4. Selects chemicals and operates pesticide dispersal equipment.

5. Provides maximum residual benefits consistent with environmental protection parameters.

6. Ensures compliance with applicable laws and directives.

7. Provides guidance and oversight for programs such as environmental compliance, conservation, and pollution prevention.

8. Initiates, maintains, and monitors environmental permits.

9. Conducts customer orientation and training courses.

10. Provides technical expertise in emergency hazardous material response actions.

11. Ensures correct use and maintenance of personal protective equipment and tools.

12. Maintains facilities, equipment, and storage areas.

13. Evaluates proposed work, determines resources requirements, and prepares cost estimates.

14. Identifies, budgets for, and acquires specialized equipment.

15. Surveys and inspects activities and facilities for accumulation point compliance and pollution prevention opportunities.

16. Maintains historical databases, tracking systems, and profile sheets.

17. Prepares and analyzes reports and recommends corrective action.

3E5X1 Engineering

1. Plans and designs site layout.
2. Prepares computerized and manual engineering plans and drawings.
3. Performs material takeoffs from construction drawings.
4. Plans and prepares cost estimates
5. Plans and prepares performance work statements
6. Plans and prepares specifications for existing and proposed facilities.
7. Designs rigid or flexible pavements.
8. Makes simple load calculations for beams, columns, floors, and roofs.
9. Acts as liaison between design, review, construction, and using agencies.
10. Interprets plans and specifications.
11. Analyzes general provisions of contracts.
12. Participates in construction conferences.
13. Documents construction activities.
14. Reviews material submittals.
15. Coordinates construction efforts.
16. Completes pre-final, acceptance, and post acceptance inspections.
17. Helps evaluate warranties and guarantees.
18. Completes processing of work clearance requirements.
19. Prepares and evaluates contract progress reports.
20. Prepares Civil Engineering related performance work statements.
21. Performs standardized tests on soils, asphalt, and concrete.
22. Performs command post duties.

23. Performs construction layout and materials testing for force beddown.

3E6X1 Operations

1. Tracks status of beddown, sustainment, and recovery operations.

2. Maintains events logs and provides updates on status of resources and actions taken.

3. Utilizes contingency, mobility, sustainment, and recovery plans to support operations.

4. Maintains accountability of resources to include personnel, material, equipment, and vehicles.

5. Interfaces with host nations on maintenance requirements, purchase agreements, and service contracts.

6. Identifies, requisitions and accounts for equipment and supplies.

7. Monitors compliance with and provide updates for recurring work program schedules.

8. Implements and monitors customer satisfaction program.

9. Responds to customer inquiries.

10. Prepares and manages work requirements during approval, processing, and completion stages.

11. Recommends method of accomplishment based on existing capabilities.

12. Develops and monitors installation work order priority program.

13. Monitors work order costs to ensure compliance with legal limits.

14. Operates computer terminals and communications equipment to support work force management activities.

15. Manages preparation and maintenance of work force management records and reports.

16. Performs quantitative study of management data to assess CE cost and reimbursement, work performance, progress, trends, standards, and policies.

17. Manages and ensures a continuous work flow.

18. Establishes priorities, manages work plans, and monitors work status.

19. Analyzes records to ensure compliance with the recurring work program and provides technical assistance.

20. Ensures identification of environmental concerns.

21. Develops and administers facility manager program.

22. Analyzes work activities and interprets findings and recommends corrective action.

23. Collaborates with engineer and environmental planning functions to prepare and execute CE programs and plans.

3E7X1 Fire Protection

1. Operates tools and equipment, controls and extinguishes aerospace vehicle fires, and performs ventilation, overhaul, and salvage operations.

2. Controls and extinguishes structural fires; performs ventilation, salvage and overhaul operations; loads hose; and makes hose load finishes.

3. Supports the electrical power production function with resetting aircraft arresting systems

4. Fights, controls, and extinguishes fires in wildland and miscellaneous areas.

5. Operates rescue tools and equipment.

6. Shuts down aircraft engines/systems, and safes egress systems.

7. Performs confined space rescue, emergency medical care, and cardiopulmonary resuscitation (CPR).

8. Performs inspections and preventative maintenance on structural, aircraft rescue fire fighting (ARFF), and support vehicles, tools, equipment, and protective clothing.

9. Performs crew duties on a Hazardous Materials Response Team.

10. Drives and operates structural fire fighting and support vehicles.

11. Performs pump operations.

12. When first to arrive at the scene, establishes command and control, and also coordinates/directs fire fighting and rescue activities until relieved by a senior fire officer.

13. Performs fire alarm communication center duties

14. Inspects, maintains, repairs, recharges, and tests fire extinguishers.

15. Identifies, inspects, and resets fire suppression/detection systems.

16. Performs Fire Prevention, Public Fire Education, and Fire Cause Determination duties.

17. Develops and coordinates pre-incident plans, mutual aid agreements, and support agreements.

18. Performs fire prevention inspections

19. Plans, schedules, conducts and evaluates training.

20. Prepares and maintains fire protection records, reports, and charts.

21. Manages all contingency, training, and fire prevention programs

22. Plans and schedules periodic facility inspections to ensure sound fire prevention practices have been implemented.

23. Prepares and coordinates fire protection mutual aid and support agreements.

24. Develops and establishes tactical fire suppression and rescue plans.

25. Analyzes fire department operations, determines trends and potential problems, and formulates corrective measures.

26. Conducts risk analysis studies and develops/implements policies or quality performance measures as required to maintain mission effectiveness.

27. Performs staff or major command visits to fire protection organizations to ensure adequate use of facilities, vehicles, and equipment.

28. Conducts investigations to determine actual or underlying causes of fire, the effectiveness of fire suppression operations, and to retrieve/validate reported fire loss cost estimates.

29. Evaluates techniques for entry to structures and aerospace vehicles to rescue personnel or recover equipment.

30. Reviews all project plans and specifications to include the AF Form 332, DD Form 1391, and project books for technical adequacy of fire protection features.

3E8X1 Explosive Ordinance Disposal

1. Conducts area reconnaissance for detecting and identifying unexploded ordnance.

2. Determines distances to which personnel and material must be evacuated.

3. Photographs all unknown explosive ordnance for technical intelligence.

4. Removes earth and debris surrounding unexploded ordnance.

5. Estimates depth of buried explosive ordnance by using probing techniques or detection equipment.

6. Performs constructing, sinking, and timbering of shafts for access to buried explosive ordnance and to protect personnel during recovery operations.

7. Performs necessary rendering safe procedures.

8. Removes safe explosive ordnance by using winches, pulleys, cables, or cranes.

9. Operates and interprets radiation and other detecting instruments in monitoring areas adjacent to unexploded ordnance suspected of containing toxic or radioactive contamination.

10. Neutralizes, leak seals, packages, and disposes of chemical and biological munitions.

11. Disposes of explosive ordnance rendered exceptionally hazardous by damage or deterioration.

12. Disposes of unserviceable explosives by thermal treatment.

13. Notifies authorities when areas are free of danger.

14. Secures explosive ordnance and equipment to vehicles and plans evacuation routes.

15. Prepares reports concerning explosive ordnance disposal activities.

16. Fabricates and uses explosive charges.

17. Neutralizes and disposes of improvised explosive devices.

18. Performs as a specialized member of the Base Emergency Response Force to provide guidance and advice to the On-scene Commander.

19. Safes, removes, and disposes of explosives, explosive devices, and explosive ordnance rendered hazardous.

20. Conducts explosive ordnance indoctrination programs for disaster preparedness teams and other agencies.

21. Maintains explosive ordnance publications.

22. Inventories, stores, and maintains supplies, tools, and equipment relative to explosive ordnance disposal.

3E9X1 Readiness

1. Conducts research and assists in development of disaster preparedness plans.

2. Coordinates actions to allow continuation or restoration of vital functions and operations.

3. Prepares checklists and operating instructions for readiness activities.

4. Extracts tasking from the time-phased force deployment list to develop plans for contingency, mobility, and recovery.

5. Establishes, coordinates, conducts, and monitors Prime BEEF program operation.

6. Analyzes training and deficiencies for wartime tasks.

7. Identifies, budgets, requisitions, and accounts for equipment and supplies used by readiness and contingency teams.

8. Inputs, maintains, reviews data, and prepares Status of Resources and Training System (SORTS) reports.

9. Identifies and prepares personnel for individual CE AFS contingency deployments.

10. Provides briefings and develops installation disaster preparedness training and educational materials.

11. Inspects equipment.

12. Ensures disaster preparedness teams are established and manned.

13. Acts as exercise evaluation team member for CE Readiness Flight and ensures exercises are conducted according to directives.

14. Ensures authorized and required NBC protective equipment and clothing, detection devices, and monitoring instruments are available, calibrated, and in operating condition.

15. Monitors actions to preserve life, minimize damage, and restore operations following natural disasters, accidents, and wartime attacks.

16. Requisitions supplies and equipment for the CE Readiness Flight and disaster preparedness support team (DPST).

17. Maintains custodial files for accounts, such as supply and equipment, intrabase radio, and test, measurement, and diagnostic equipment (TMDE).

18. Conducts unit and staff agency assistance as needed to ensure disaster preparedness planning and training has been accomplished and disaster preparedness analysis is done.

19. Monitors contamination control, measures contamination, and coordinates and implements exposure control procedures.

20. Serves in mobile or unit command post, survival recovery center, or NBC control center.

21. Monitors force survivability and advises the Readiness Flight officer or NCO of deployment and employment capabilities.

22. Establishes an integrated conventional and NBC detection network.

23. Helps prepare for conventional and NBC defense, including activating NBC teams for shelter, decontamination. monitoring, plotting, and reporting.

24. Coordinates protective shelter stocking.

25. Reviews findings of personnel operating detection equipment, and compiles data to indicate danger areas.

26. Manages activities in the Nuclear, Biological, Chemical Control Center (NBCCC).

27. Operates mobile command post and disaster preparedness communications net.

28. Determines contamination levels and amount over a given area and, in conjunction with medical personnel, recommends time limits that personnel may remain in the area.

29. Ensures emergency processing procedures are established for personnel decontamination at the contamination control line.

30. Ensures clothing can be exchanged and subsequent decontamination or disposal of clothing and other material is accomplished.

31. Utilizes data automation processing equipment and software including word processing, graphics, mapping, and database management programs.

32. Ensures safety procedures are followed.

Appendix B
Priority Listings

Priority 1 Taskings.

a. Runway Preparation. Consists of inspection, cleaning, and striping of runways, as required. Also includes placement of appropriate markers, e.g., distance-to-go signs.

b. Runway Edge and Approach Lights. Required when night combat operations are necessary or a sustained logistics buildup is needed. Runway edge lights must be installed by nightfall of day one.

c. Navigational Aid Sites. Involves site preparation to position NAVAIDs on clear and level surfaces.

d. Mobile Aircraft Arresting System (MAAS). Installation of a MAAS where permanent or expedient aircraft arresting systems are inoperable or nonexistent.

e. Emergency Pavement Repairs. A runway condition survey determines the scope of this task. Other considerations may include early expansion requirements and threat of attack.

f. Water Point. Requires clearance of an access route to a water point or source when installation of the water system is blocked by obstructions.

g. Water Treatment Plant(s). Installation of water plants so that potable water is available.

h. Functional Groups and Facilities. The location of functional groups and facilities is marked by survey stakes or other expedient marking devices.

i. Water Distribution System. Installation of pipes, pumps, and storage tanks. Also includes installation of fill stands for firefighting and domestic fill points.

j. Mission Essential Power. Installation of MEP generators to provide temporary power to mission essential functions.

k. Primary Power. Installation and operation of the primary generation and distribution system.

l. Latrines. Requires establishment of expedient latrine facilities or erection of field deployable units.

m. Dining Hall. Provision of electrical power and water to food service facilities, and construction of flooring.

n. Control Center. Erection of the civil engineer shelter by personnel not performing other Priority 1 tasks.

o. Medical Treatment Facilities. Assistance provided for erection of medical shelters (when requirement exceeds medical unit's organic capabilities), and connection of medical facilities to bare base utility systems.

p. Fire Protection. Provision of fire protection, crash rescue, and minimal first aid services.

q. Warning System/Giant Voice Systems. Installation and operation of base alerting systems.

r. Unexploded Ordnance. A survey of the complete beddown area must be performed for presence of surface and subsurface unexploded ordnance.

Priority 2 Taskings.

a. Airfield Clear Zones. Removal of major obstructions that endanger safe landing, taxiing, and takeoff.

b. Aircraft Ramps and Aprons. Sweeping, cleaning, and repair of aircraft ramps and parking areas.

c. POL Storage. Leveling of fuel bladder sites and construction of protective earth berms and dikes.

d. Aircraft Arresting Systems. Operational check of these systems prior to the arrival of fighter aircraft.

e. Ammunition Storage. Site clearance, leveling and start of berm construction in preparation for arrival of munitions.

f. Static Grounds. Installation of static grounds and tie-downs at fueling points, munition arm and dearm pads, hot cargo (munitions and hazardous materials) off-loading pads, and parking areas.

g. Showers. Installation of personnel showers and temporary Wastewater drains.

h. Facilities. Erection of engineer shops and billets, and provision of technical guidance for shelter erection to other base functions, using personnel not assigned to Priority 1 work.

i. Expedient Runway Repair. Accomplishment of expedient runway repairs to the extent required by the runway condition.

j. Expedient Aircraft Ramp Extensions. Construction of additional aircraft pavements, ramps, and aprons, when required, must be started early to prevent delay of logistics buildup. Expeditionary paving materials, such as AM-2 or fiberglass matting, are used.

k. Aircraft Revetments. Construction of revetments for the protection of tactical and strategic aircraft.

l. Security Fences and Anti-Vehicular Obstacles. Construction and installation of perimeter and access way security features.

m. Entomology. Provision of entomological services to rid an installation of pests and maintain a sanitary environment under austere conditions.

n. Environmental Quality and Control/Disposal of Hazardous Materials. Cleanup of hazardous materials found upon arrival at an installation and proper control of any such materials generated during base buildup and operation.

Priority 3 Taskings.

a. Electrical Service. Extension of electrical service to all base facilities; installation of MEP generators in emergency backup power modes.

b. Base Roads. A continuing task that must be expedited to permit an unimpeded flow of facilities and logistic materials from the off-load ramp to the buildup sites.

c. Sanitary Fill. Construction of trenches and burn pits for the disposal of solid wastes.

d. Wastewater Lagoons. Construction of Wastewater lagoons when required by environmental conditions.

e. Sewage Collection Systems. Installation of pipes, sump pumps, lift stations, and other components of the sewage collection system; provision of bare base site drainage; and connection of showers and latrines to the sewage collection system.

f. Flooring. Construction of flooring for non-critical facilities which was omitted during initial erection of these shelters.

g. Grease Pits, Septic Tanks, and Leaching Fields. Construction of grease traps at kitchens and required shops; installation of septic tanks and leaching fields for facilities that required Wastewater disposal but are not tied into the sewage collection system.

h. Washrack. Construction of washrack to meet aircraft maintenance requirements.

i. Facility Hardening. Use of expedient methods (sandbags, protective earth berms, revetments, digging-in) to harden critical facilities.

j. Camouflage, Concealment and Deception (CCD). Application of CCD measures to counter the enemy threat.

k. Decoys. Assembly, placement, and maintenance of decoys.

l. Air Base Defense (ABD). Construction of defensive positions for the ABD force when threat conditions dictate their preparation as a Priority 3 task.

m. Emergency Disposal Range. Preparation of a land area to be used by EOD for munitions destruction.

Priority 4 Taskings.

a. Operations and Maintenance. The continuation of other tasks, as needed, to include operation and maintenance of bare base and existing facilities, utilities, roads, pavements, and similar bare base priorities.

b. Contingency Response Plans. Development and update of contingency plans to include base recovery after attack and natural disaster responses.

c. Training. The training and rehearsal of contingency tasks which should include security measures, base recovery, and base denial.

d. Quality of Life Improvements. Provision, as time permits, of improvements to facilities and utilities such as increased square footage, more access points, hot water, air conditioning, etc.

e. Recreation Support. Construction of basic recreational facilities and fields and supplying utilities to these facilities as necessary.

f. Resource Accountability. Establishment of controls over materials, equipment and vehicles to preclude loss, damage or unauthorized use. Includes inventory, assignment of responsibility, and provision of protective features such as fencing, shelters, lighting, etc.

Appendix C
Flow Diagram Mathematical Equations

Cost Determination

- Cost_Per_Year = Current_Military_Authorizations*Cost_Per_Year_Per_Man
- Cost_Per_Year_Per_Man = 35000

Current Military Authorizations

- Current_Military_Authorizations(t) = Current_Military_Authorizations(t - dt) + (-Outsourcing_or_Insourcing) * dt
  INIT Current_Military_Authorizations = 1948
  OUTFLOWS:
  - Outsourcing_or_Insourcing = Multi_Formula

Decision Maker's Value Profile

- AF_Established_Min_Manning = 1499
- Cost_Weight = .6
- C_max = 68180000
- Max_% = .05
- Max_allowable_Sourcing_per_dt = Current_Military_Authorizations*Max_%
- Readiness_Weight = 1-Cost_Weight
- R_max_excess = 1576
- R_min = AF_Established_Min_Manning*Risk_Factor

Establishing Readiness

- Importance_Factor = .662
- Readiness = Current_Military_Authorizations*Risk_Factor
- Risk_Factor = MEAN(Importance_Factor,War_Correlation_Number)
- War_Correlation_Number = .417

Multi Attribute Formulation

- Multi_Formula = Max_allowable_Sourcing_per_dt*(Cost_Weight*Cost_Attribute-Readiness_Weight*Readiness_Attribute)
- Cost_Attribute = GRAPH((C_max-Cost_Per_Year)/C_max)
  (0.00, 0.985), (0.1, 0.645), (0.2, 0.33), (0.3, 0.15), (0.4, 0.08), (0.5, 0.05), (0.6, 0.035), (0.7, 0.025), (0.8, 0.02), (0.9, 0.015), (1, 0.00)
- Readiness_Attribute = GRAPH(Readiness-R_min)
  (0.00, 1.00), (158, 0.665), (315, 0.39), (473, 0.245), (630, 0.145), (788, 0.105), (946, 0.075), (1103, 0.05), (1261, 0.03), (1418, 0.015), (1576, 0.00)

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Vita

Captain David J. Anason was born on 24 January 1968 in Ann Arbor, Michigan. He graduated with a Bachelor of Science in Civil Engineering from Michigan State University in June 1991. He received a reserve commission in the United States Air Force.

He was first assigned to the 50th Civil Engineering Squadron, Falcon Air Force Base, Colorado, as the SABER Chief in the Engineering Flight. One year later, he was given a new position and more responsibility as Chief of Contract Management Element. In June 1995, he moved to Reese Air Force Base, Texas where he was assigned the the 64th Civil Engineer Squadron as the Chief of Maintenance Engineering and later Deputy Commander of the Operations Flight. He enter the School of Engineering at the Air Force Institute of Technology in September 1997. Upon graduation, he will be assigned to 7th Air Force Headquarters, Osan Air Base, Republic of Korea.

Capt Anason is married to the former Stacey Lynn Oswald of Grafton, Wisconsin. They have one son, Tony Melvin, 3.

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